

# From Carbon to Light

Methodologies for Carbon Finance Monitoring and Evaluation

Lighting Africa 2010 Business Conference

Nairobi, Africa  
May 18-20, 2010



Evan Mills, Ph.D.

Lumina Project

Lawrence Berkeley National Lab

# Acknowledgements

United Nations, Framework Convention on Climate Change (UNFCCC) Small Scale Working Group; Clean Development Mechanism (CDM) Executive Board

Blum Center for Developing Economies

Lighting Africa

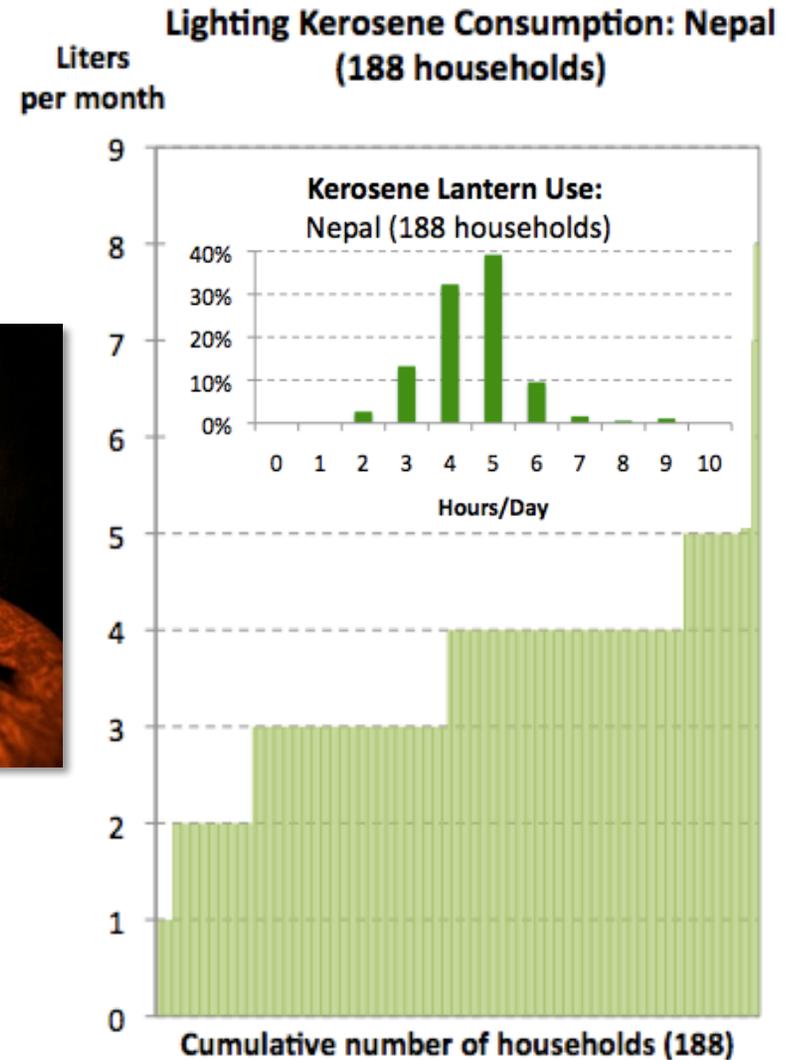
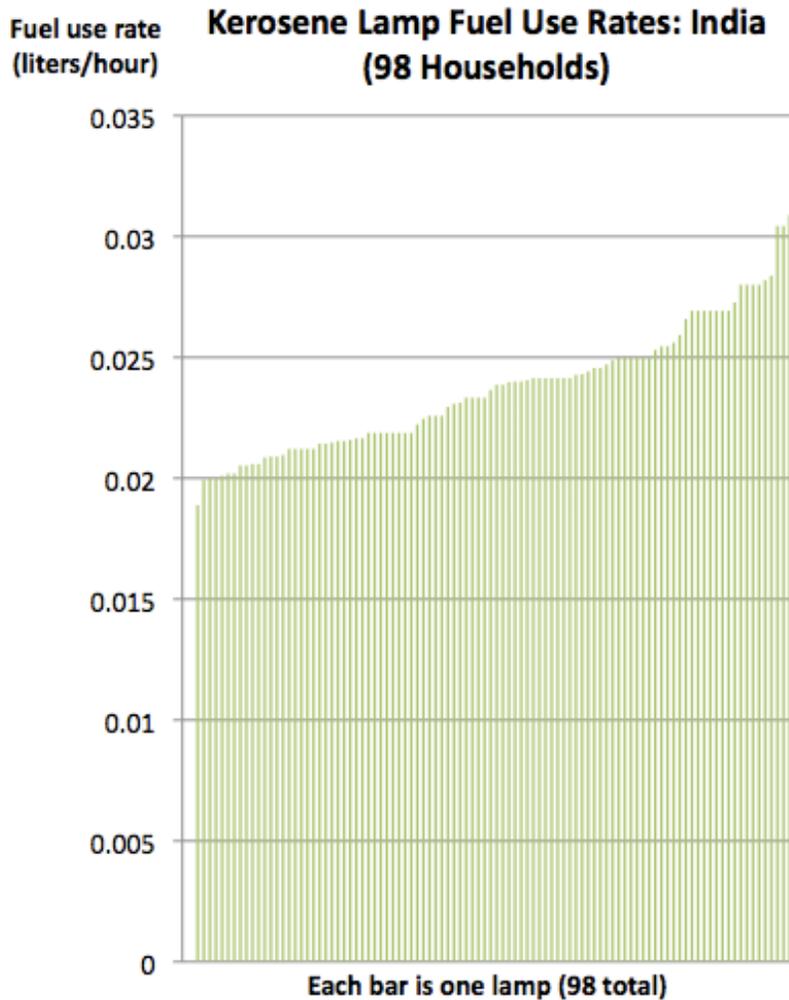
Lumina Project Team

Arne Jacobson, Peter Alstone, Jennifer Tracy, Patricia Lai, Kristen Radecsky, and Dustin Poppendieck at Humboldt State University. Jessica Granderson, Jim Galvin, and Francis Rubinstein at Lawrence Berkeley National Laboratory. Maina Mumbi and Francis Ngugi in Kenya.

# Making Light off the Grid

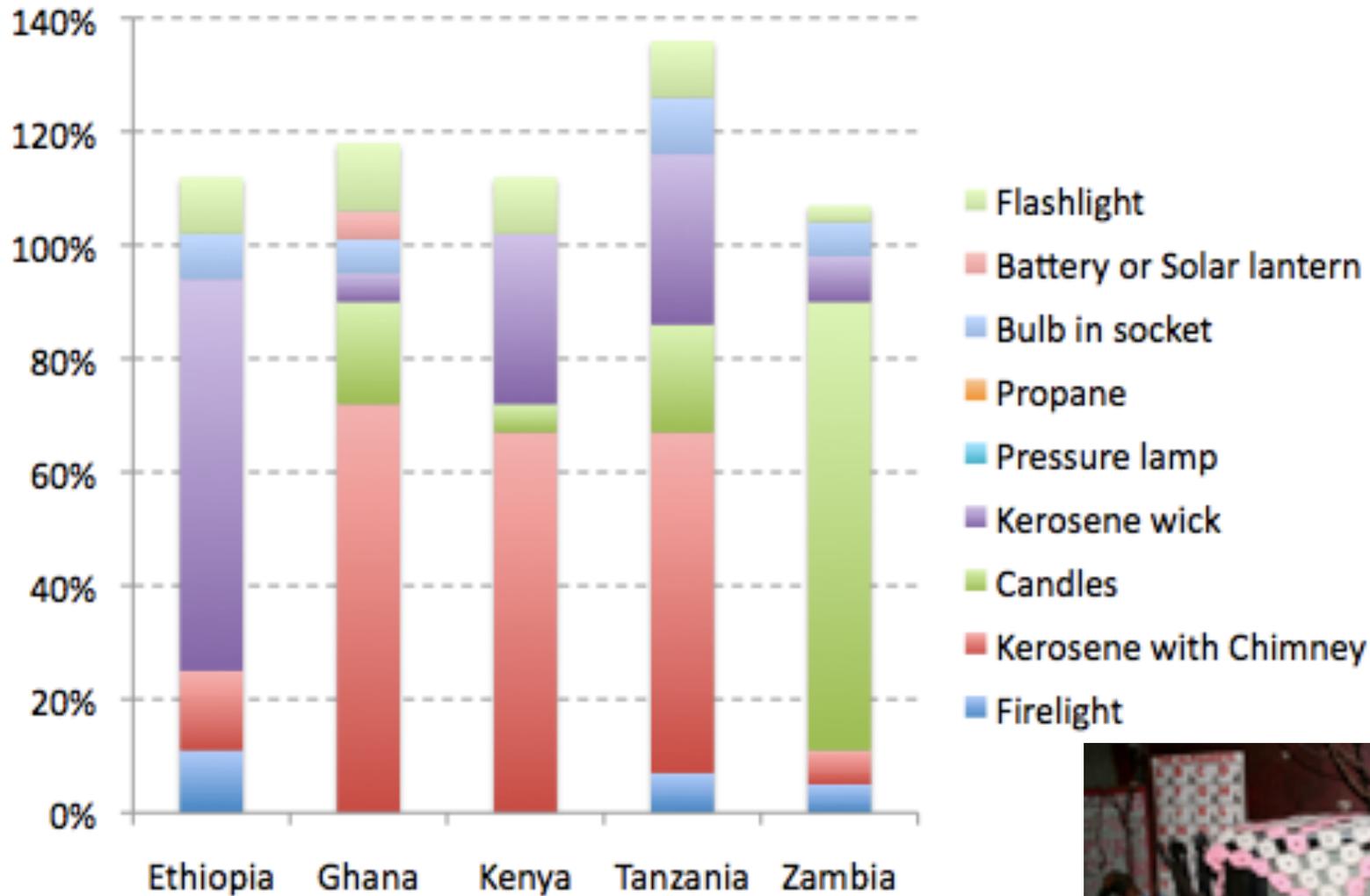


# Fuel Use Rates & Monthly Consumption



Sources: Karnataka (left) (CDM 2009) Nepal (right) (Stewart Craine, Barefoot Power)

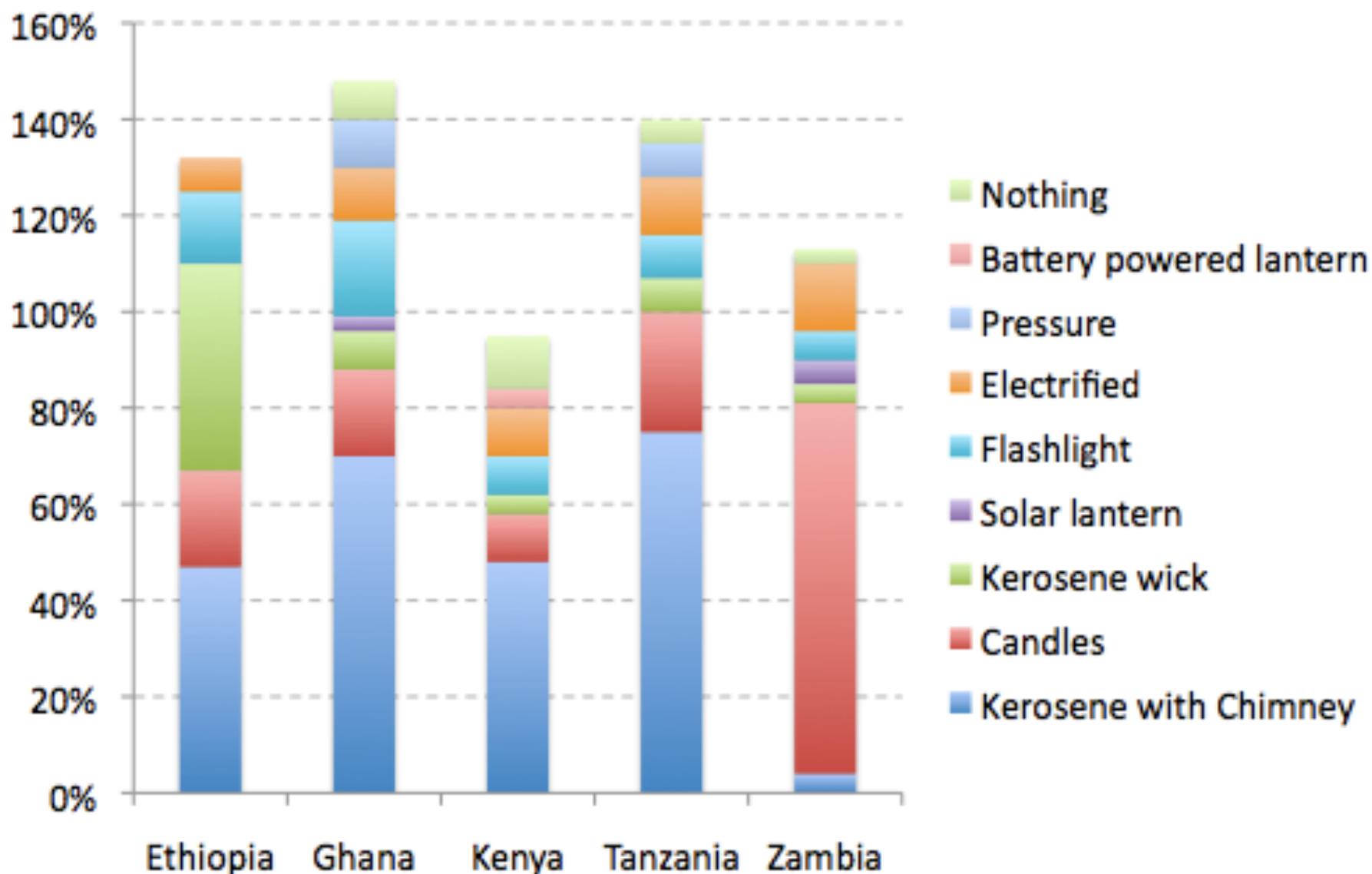
## Mix of Lighting Sources: Consumers (% using, 2008)



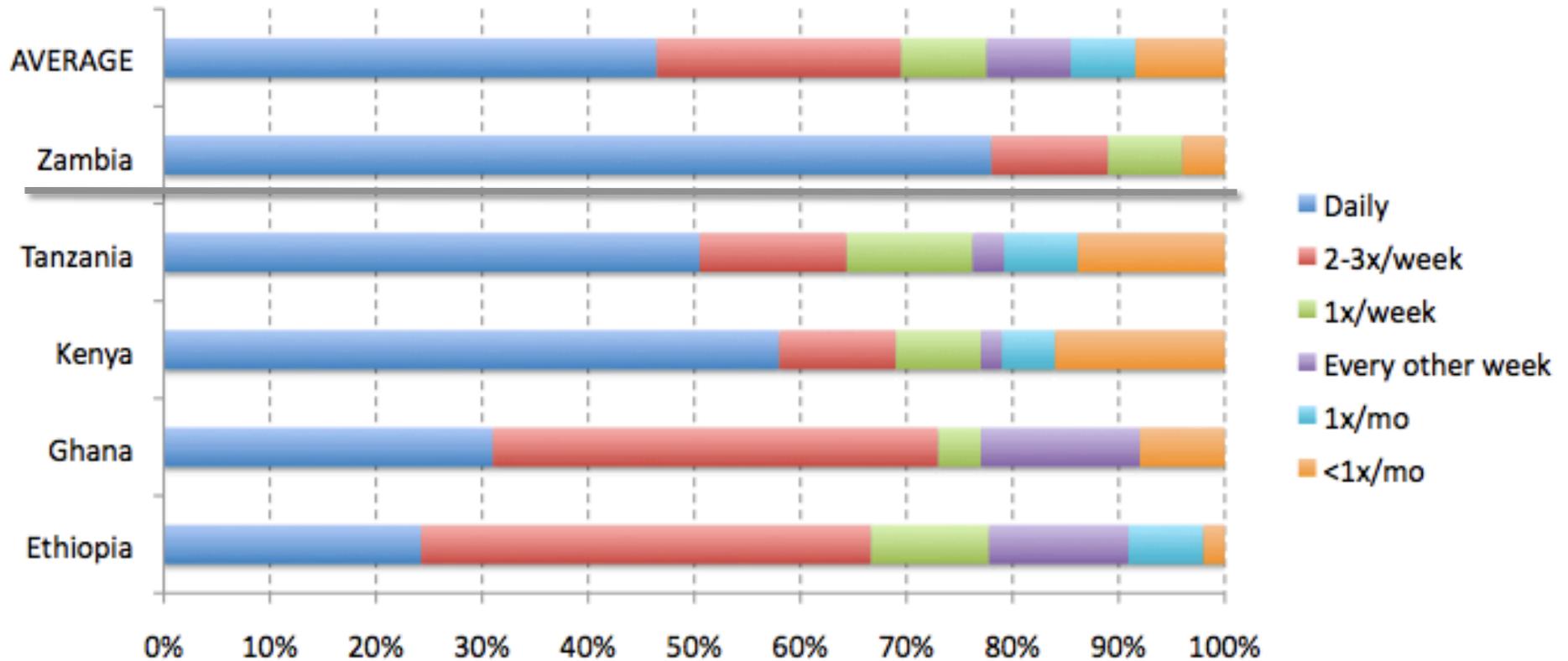
Source: Lighting Africa, Market Research (2009)

Photo: Evan Mills

### Mix of Lighting Sources: Traders (% using, 2008)



# Fuelwood for Lighting



Source: Lighting Africa, Market Research (2009)

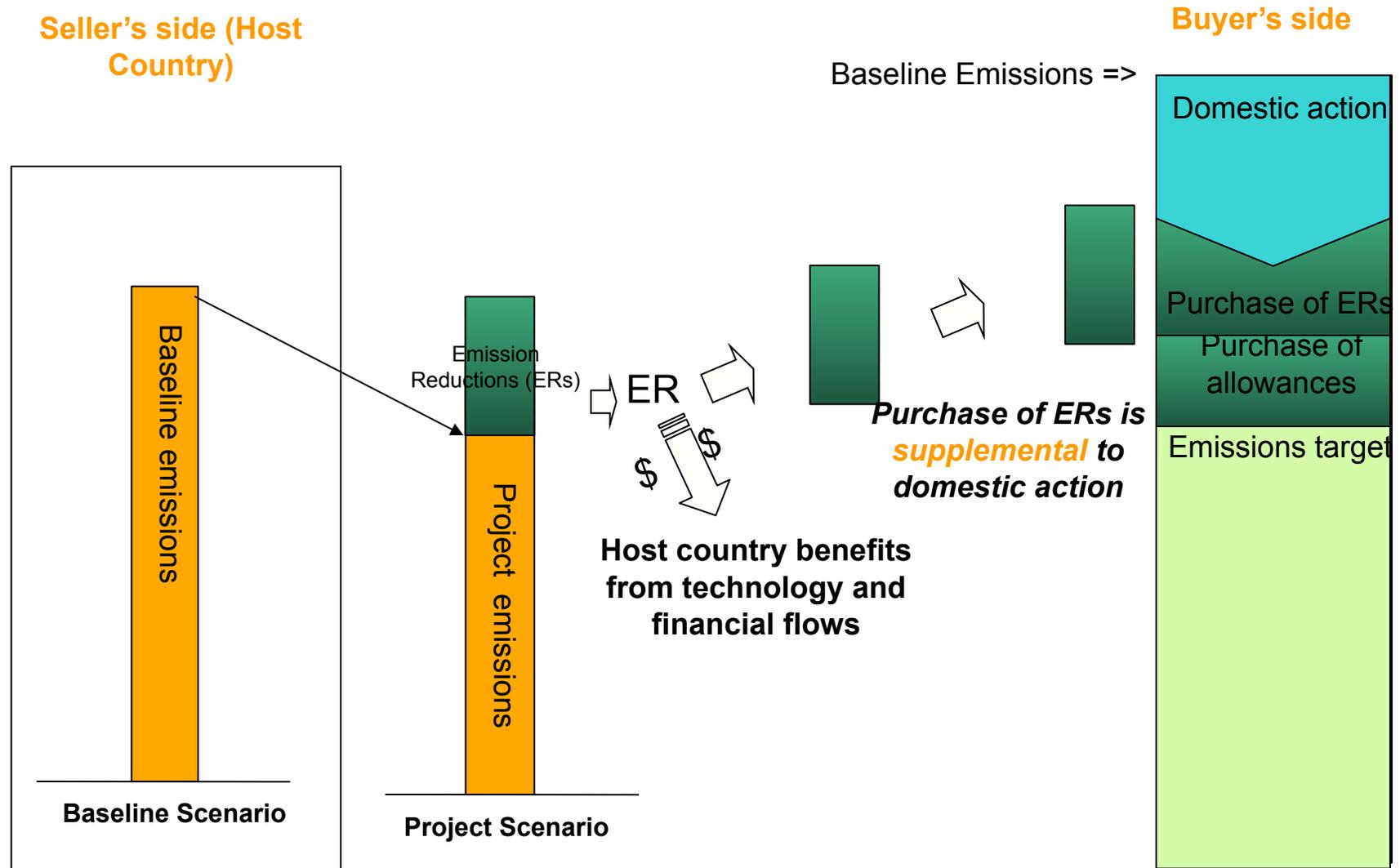


# Enabling Policy for Valuing Carbon

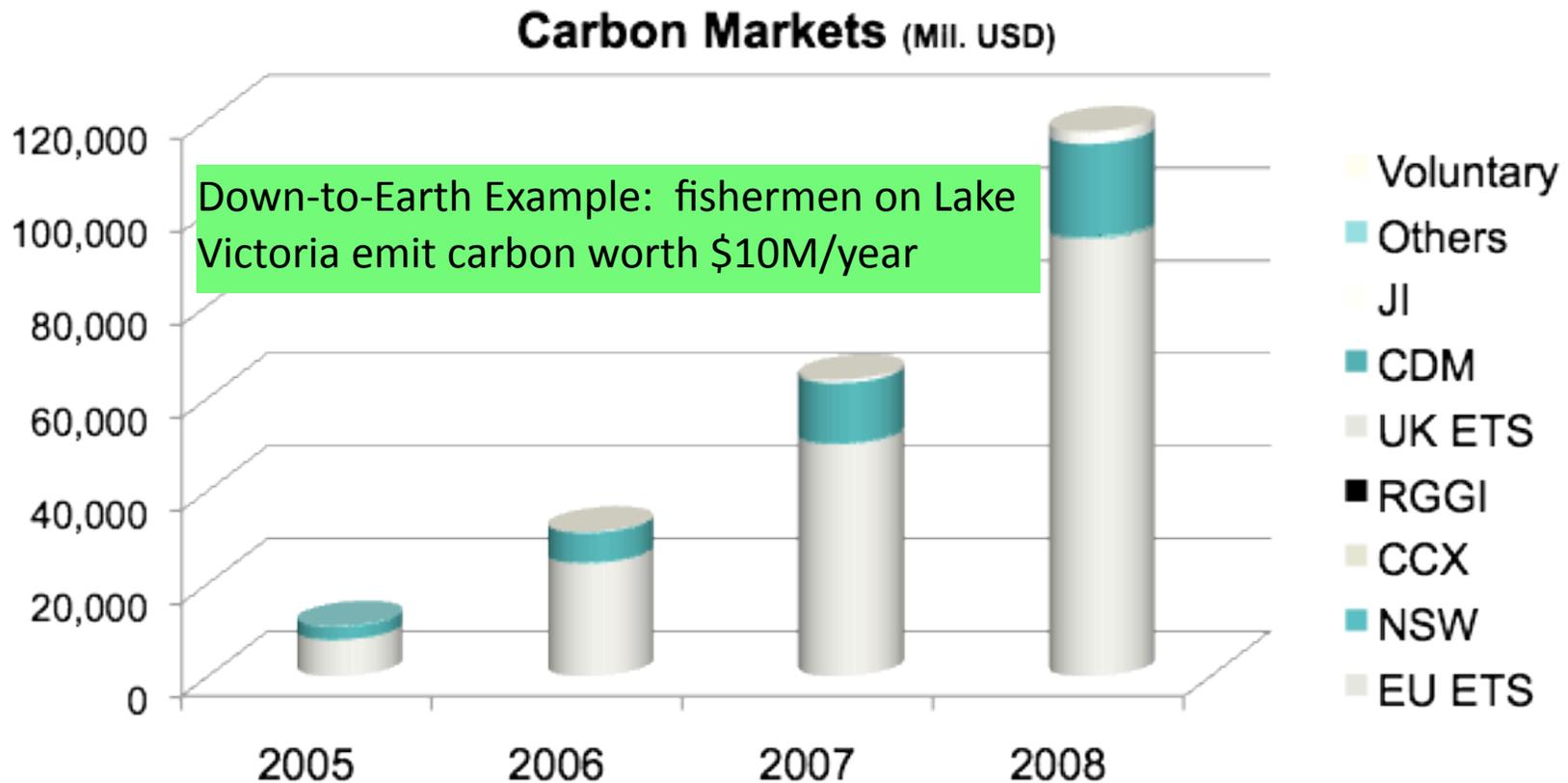
- Kyoto Protocol: Reduce GHG emissions by 5.2% below 1990 levels between 2008 & 2012
- This created a multi-\$-billion market
- Achievable through “Flexible Mechanisms”
  - Tradable or salable credits from projects in developing countries (CDM) - “Certified Emissions Reductions, CERs”
  - Credits from projects in economies in transition (JI)
  - Trading of allowances (e.g. to comply with a Cap)
  - Involves complicated process of verification and quality control

# How Carbon Trading Operates

- Kyoto Protocol: Reduce GHG emissions by 5.2% below 1990 levels between 2008 & 2012 --> CDM



# Growth of the Carbon Market

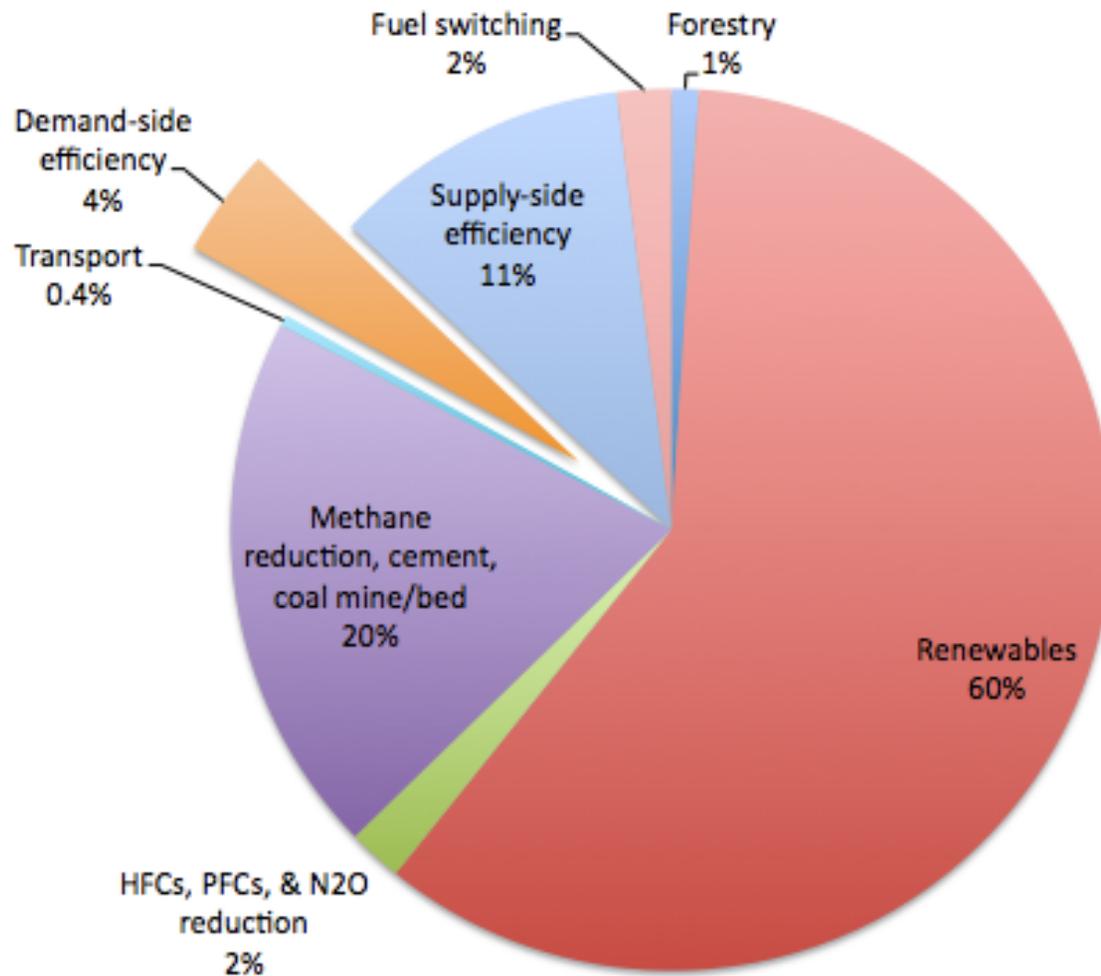


MIL. USD	2006	2007	2008
<b>Compliance Markets</b>	31,165	63,770	117,084
<b>Voluntary Markets</b>	70	265	499

Source: A. Lim. 2009. "Carbon Trading and the Kyoto Protocol." World Bank, Europe and Central Asia Region.

# Types of CDM Projects: March 2010

Household  
CER's  
issued = 0



# Critical issues for LED Projects

- Baseline (and trends)
- “Suppressed demand”
- Performance & life of replacement product
- “Leakage”
- “Additionality:”  
Net savings, investment barriers, technological barriers, viable alternative, no policy pre-emption

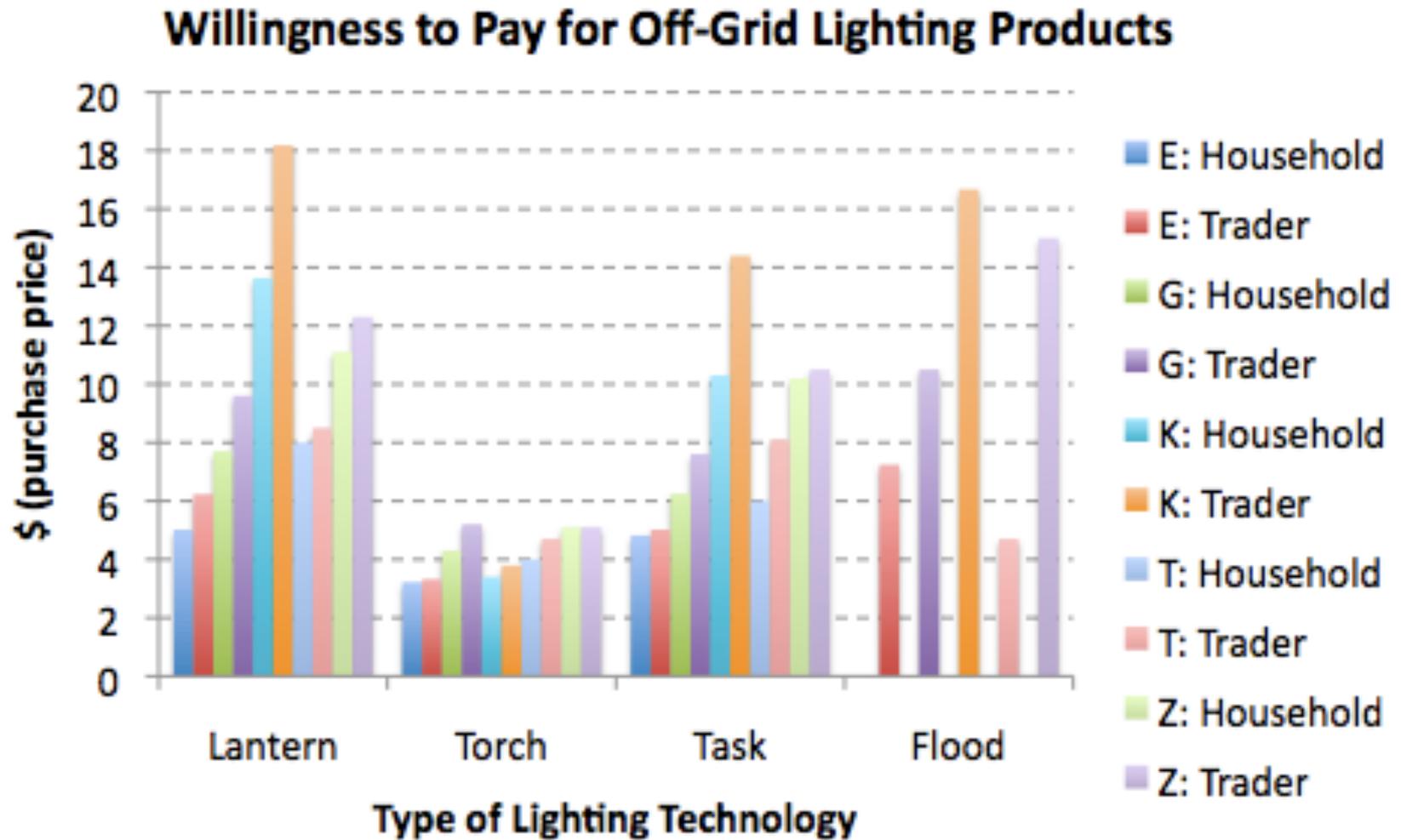


Photo: Evan Mills

# Additionality

- **Investment Barrier**
  - A more financially viable alternative can lead to higher emissions
- **Technological Barrier**
  - Less advanced technology leads to higher emission
- **Common Practice Analysis**
  - Prevailing practice, existing regulatory or policy requirements
- **Benefits Analysis**
  - A more viable strategic alternative can lead to higher emissions

# Useful Lighting Africa Market Research



Source: Lighting Africa, Market Research (2009) E= Ethiopia; G=Ghana; K = Kenya; T=Tanzania; Z = Zambia

# Existing CDM System is Broken

- Not designed for small-scale technologies
- Narrow focus on factors such as lamp fuel use rates and hours of use
- High costs of verification imposed on project developers
- Lack of standardization of assumptions/ methods



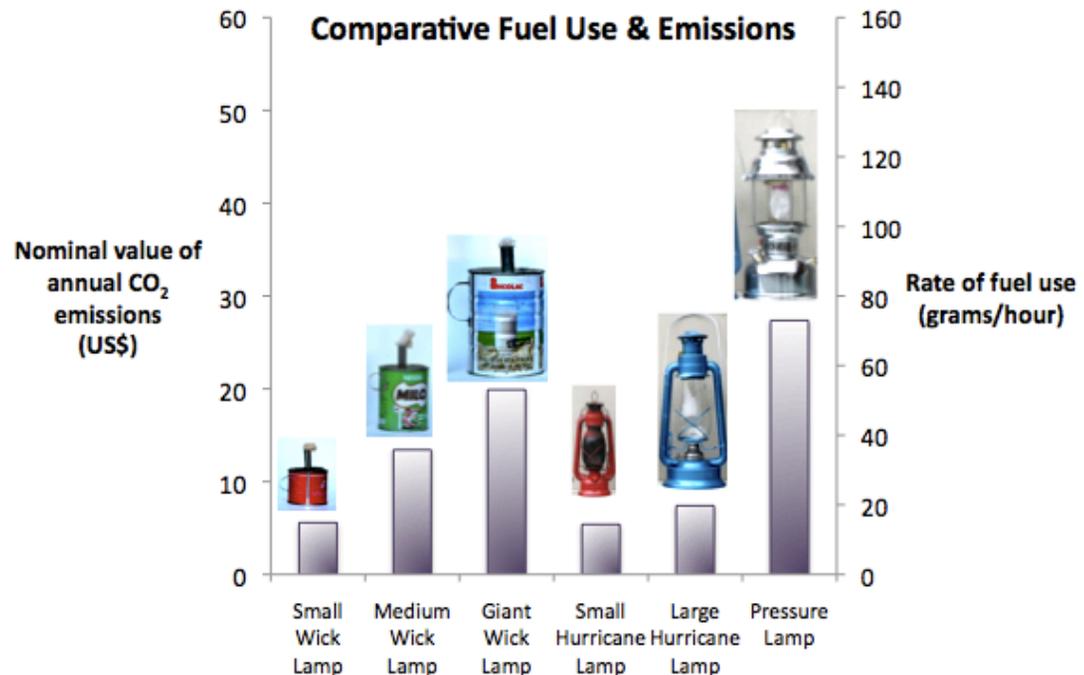
Photos: Evan Mills & Peter Alstone

# Toward an Improved Methodology

- Deemed baseline (no costly market research; project developer has option to refine)
  - Displaced fuel: kerosene
  - Consumption: 0.025 liters/hour
  - Utilization: 3.5 hours/day
  - Dynamic baseline: 5%/year kerosene growth



Photo: Evan Mills



# LED Default Values + Modifiers

- Deemed LED attributes (developer can refine)
  - LED-Kerosene lamp replacement: 1:1
  - Leakage: 1 hour of LED replaces 0.5 hours of kerosene
  - LED technology: 5mm
  - Service life: 2 years
  - Power conversion losses for grid charging: 25%



Photo: Peter Alstone

# Default Carbon Credit Value

- Result: ~0.15 tonnes CO<sub>2</sub>/lamp ~ \$3 per lamp



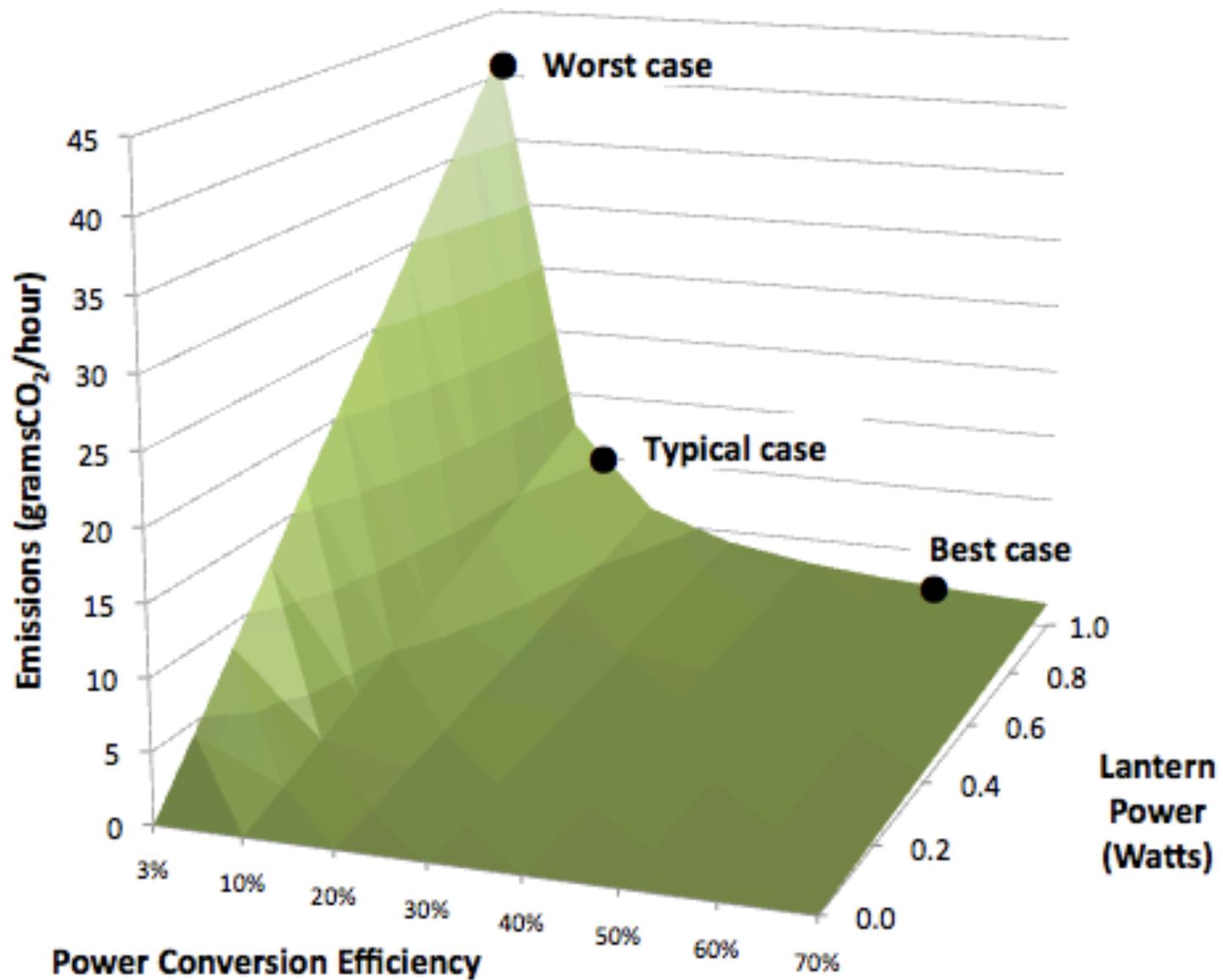
Photo: Evan Mills

# Key Modifiers for LED Projects

- LED type & powering
- Battery replaceability
- Multifunction vs. dedicated lighting
- Charity or purchased
- Warranty
- PV or grid charged
- Quality rating / Truth-in-advertising



## CO<sub>2</sub> Emissions from Grid-Charging LED Lanterns



Source: Mills, E. 2010. "From Carbon to Light." Lumina Project Technical Report #5.

# Enormous Range of LED Quality

Efficacy of White LEDs from China  
(tested at 20 mA)

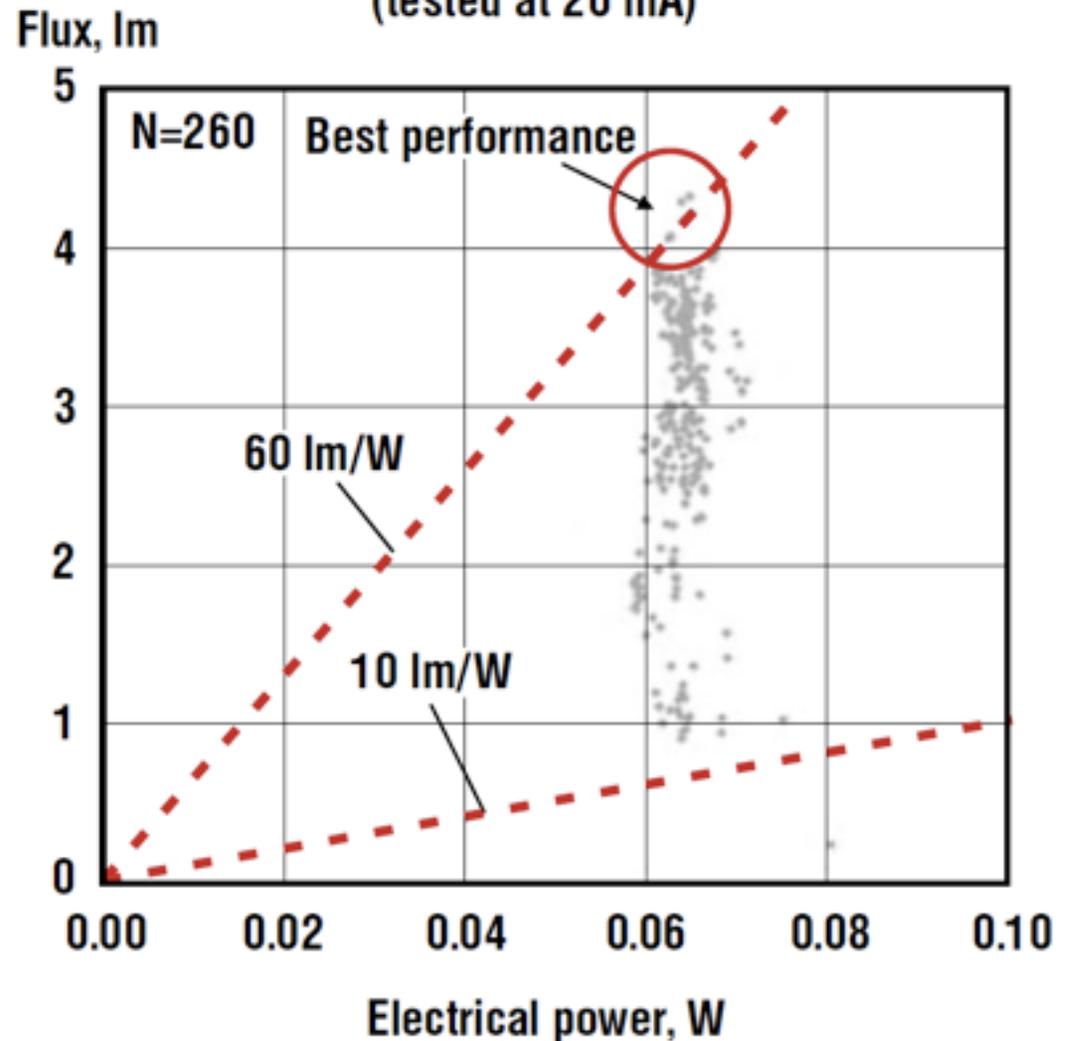
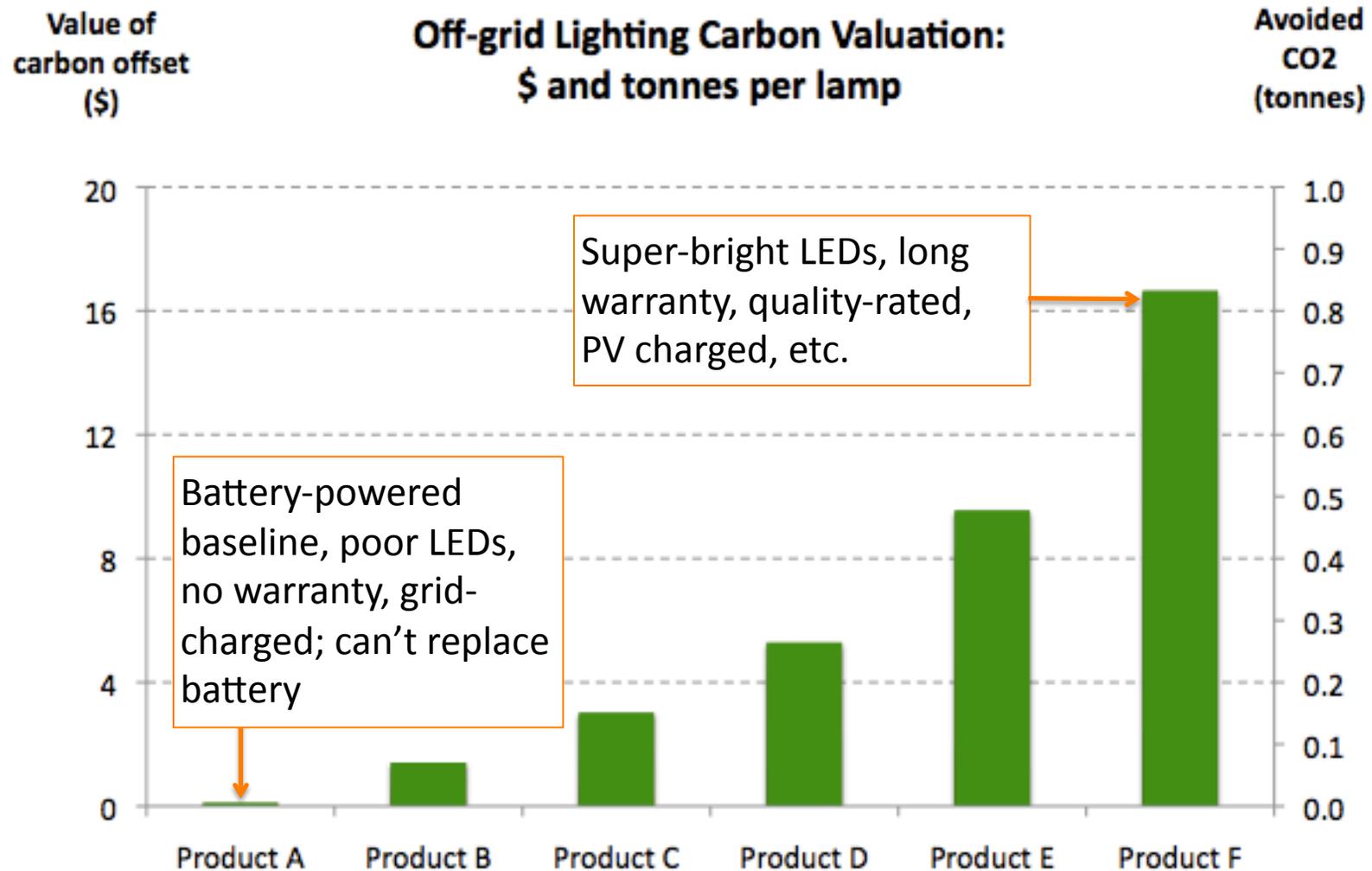


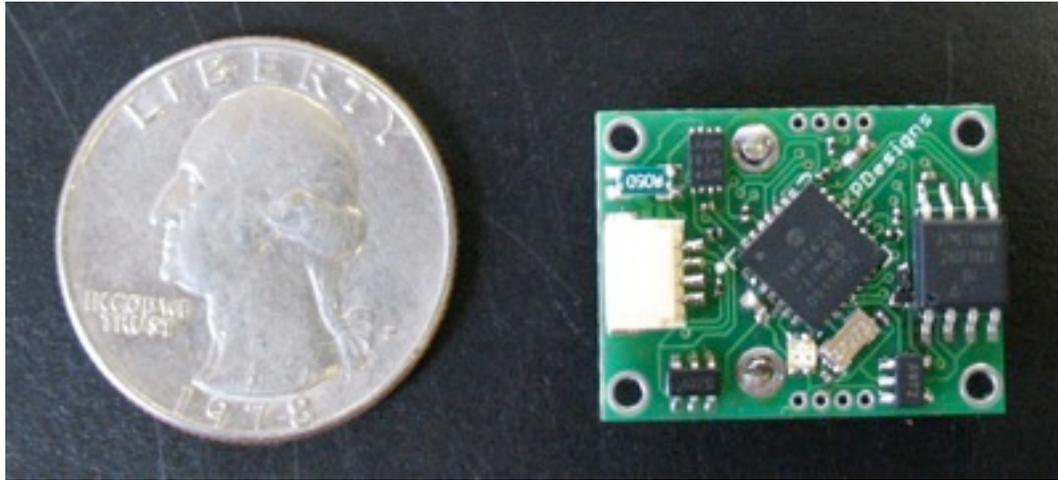
Photo: Evan Mills

Source: Mills, E. 2007. "Assessing the Performance of 5mm White LED Light Sources for Developing-Country Applications." Lumina Project Research Note #1.

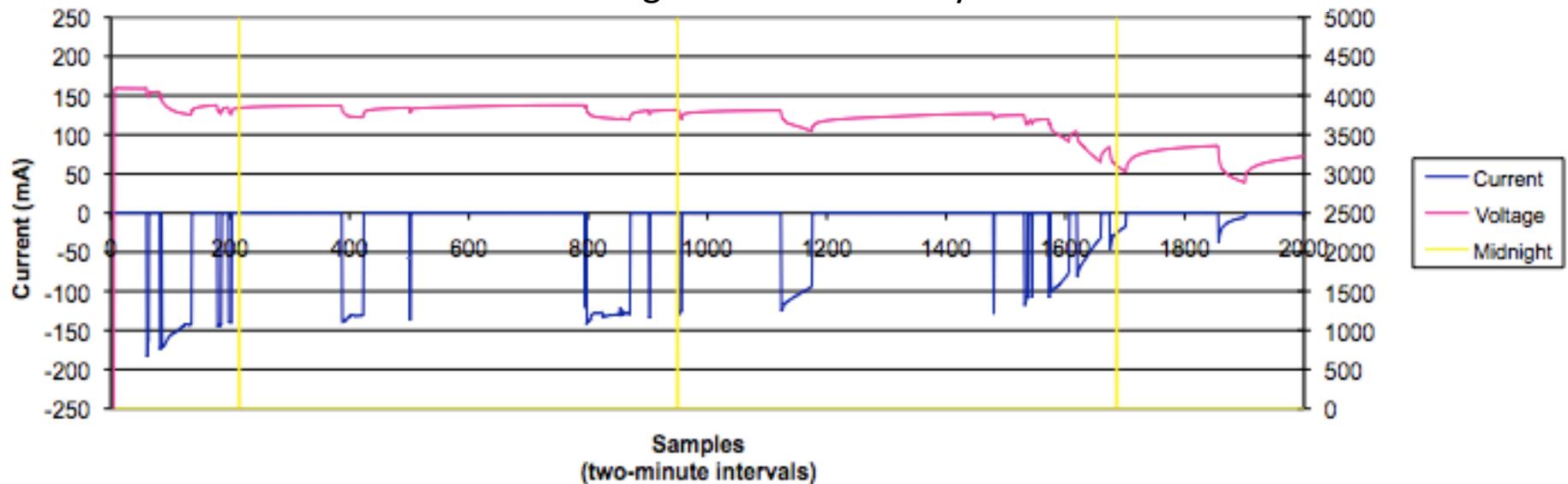
# Recommendations to UNFCCC on LED Project Emissions Accounting



# Development of micro data logger



Measured LED Lantern Usage over a Three-day Period: Africa



Source: Lumina Project (LBNL/HSU)



India: street vendor  
(Varanasi)

Thank you!  
[emills@lbl.gov](mailto:emills@lbl.gov)  
<http://light.lbl.gov>

HOME > Search

# THE LUMINA PROJECT

Cultivating Technologies and Markets for Affordable Low-Carbon Off-Grid Lighting in the Developing World

- HOME
- ABOUT
- IN THE FIELD
- IN THE LAB
- DEVELOPERS TOOLKIT
- PRODUCTS
- LIBRARY
- NEWS

**What You'll Find on Our Site:**  
Conducting field research, demonstrations, and market research on off-grid LED systems.  
[In the Field](#)  
Employing laboratory assessments and identifying deficiencies best practices to avoid market spilling.  
[In the Lab](#)  
A list of commercially available products and links to some of them.  
[Products](#)

**Our Library of Publications, Presentations and Photos:**  
Read our reports and presentations, view photos from the lab and field, and tap our bibliography of work by others. [Library](#)  
Browse our collection of photographs taken on research and project trips around the world. [Photographs](#)  
Showing: Maai Mahlu Secondary School Environmental Club

**What's New:**  
[Market Test with Night Vendors in Kenya](#)  
[Product Testing](#)  
[Indoor Pollution Measurements](#)

**Google Map:**  
Check out our map showing pilot projects and market research by diverse organizations throughout the world. You can add your organization and projects to this map.

©2009 Energy Analysis Dept | Environmental Energy Technologies Division | Berkeley Lab | Department of Energy | Disclaimer | Contact